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Production of Canned Pulp-Fortified Red Grapefruit Juice

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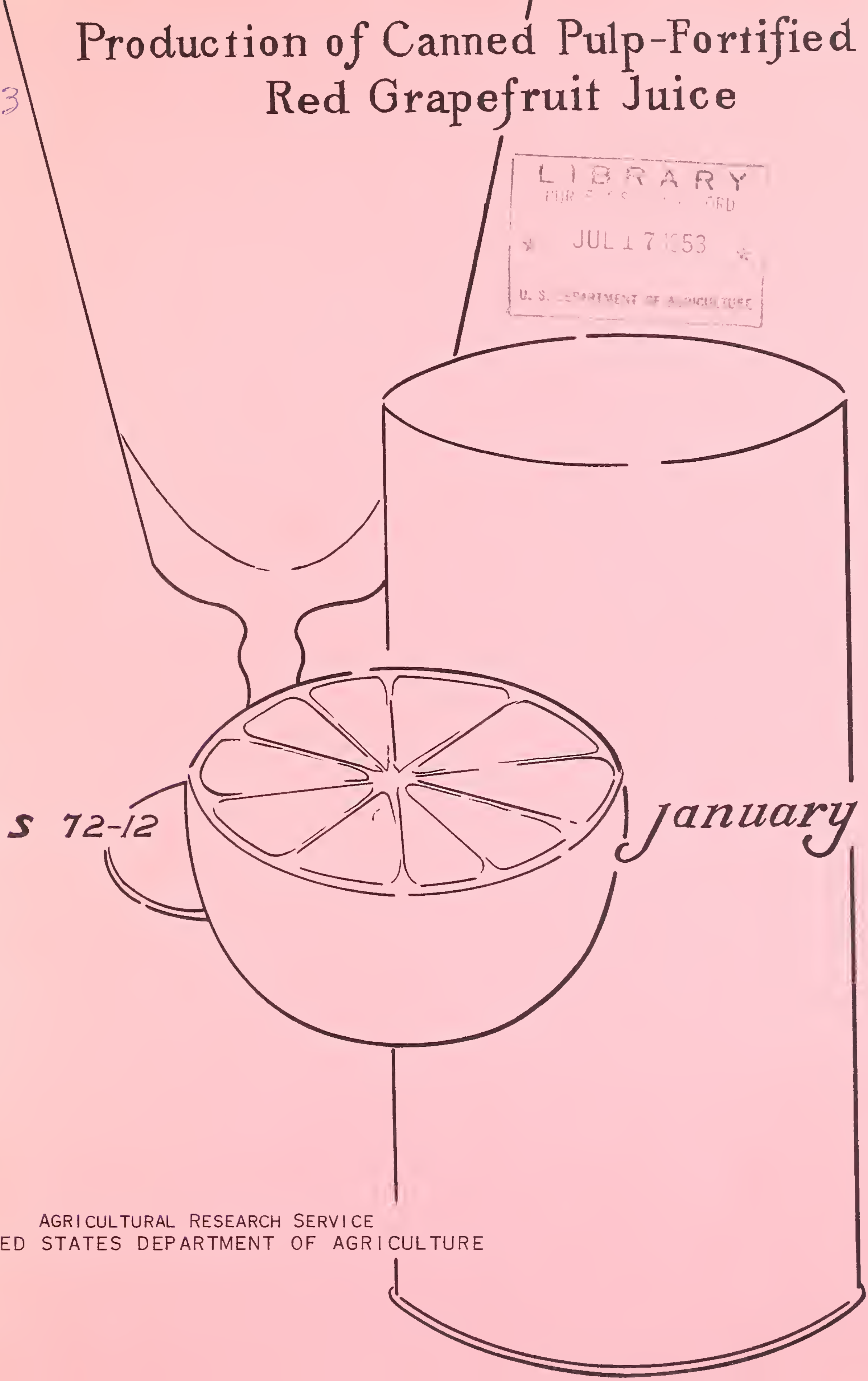

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A high quality canned single strength pulp-fortified juice product possessing a distinctively red color may be made from red grapefruit by the proper adjustment of the pulp content as the processing season progresses. This adjustment serves to control depth of color and degree of bitterness. The pulp should be finely divided to give improved color and solids suspendibility to the product and to prevent a pulpy "taste." Red grapefruit should be processed separately from the pink and white varieties. The higher pulp content increases the yield of product per ton of fruit which should offset any additional processing cost.

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PRODUCTION OF CANNED PULP-FORTIFIED RED GRAPEFRUIT JUICE

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B. J. Lime, T. S. Stephens, and F. P. Griffiths

Introduction

The canning of single strength pulp-fortified red grapefruit juice has received very little attention commercially in recent years because production of colored fruit has not been very high by comparison with white, and because processing difficulties are encountered. The present outlook for increased production of red grapefruit is, however, exceptionally good.

Texas grows more pink and red grapefruit than any other State, although there are smaller acreages of these varieties in Florida, Arizona, and California. Replantings in the Texas citrus area in the Lower Rio Grande Valley since the freezes of 1949 and 1951 have ranged from 0.5 to 1.5 million trees a year; and approximately 75 percent of the trees have been red grapefruit. It is estimated that as production increases and standards for fresh fruit are raised, 25 to 40 percent or more of the red grapefruit may be available for processing. Pink and red grapefruit present special utilization problems because of the presence of carotenoid pigments in the fruit.

The technology of processing is complicated by the fact that the principal pigments, carotene and lycopene, are insoluble in the juice, are contained in the suspended solids of the juice, and vary in quantity according to the time of harvest and variety.

White grapefruit contains very little pigment. It yields a canned juice having the typical "white" appearance to which the grapefruit juice consuming public has become accustomed (4). [b]

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[a] One of the laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

[b] Numbers in parentheses refer to Literature Cited, page 10.

Colored grapefruit, on the other hand, when processed by conventional methods yields a canned juice which has a reddish gray tinge. Moreover, under certain conditions of storage an objectional discoloration occurs which has been variously described as dullness, muddiness, or browning. Prior to 1949 the juice from the small amount of this grapefruit that reached the cannery was blended with large quantities of juice from white fruit with little adverse effect upon the color of the white juice products. With the larger quantities of colored grapefruit now becoming available for processing, a method of utilization other than blending the juice of colored and white fruit is necessary.

A solution to the problem of utilizing more red grapefruit may be to can single strength pulp-fortified red grapefruit juice products. General information and data are provided in this paper which will be helpful in the manufacture of these products.

Relationship of Suspended Solids to Color and Bitterness in the Canned Juice

In the utilization of red grapefruit for the manufacture of juice products it is desirable to enhance the color of the juice with as much of the natural coloring material as possible. This can be accomplished by the addition of the proper amount of colored pulp. The bitter principle, naringin, contained in the pulp is the limiting factor in the use of pulp to improve the color. Consideration must be given to the fact that both the color and bitterness in fruit diminish as the season progresses. Therefore, to maintain adequate color in the juice product the pulp content must be increased as the color decreases, but care must be taken not to exceed the maximum acceptable naringin level.

Table 1 shows the relationship of the suspended solids content (4) of the juice to its color. Color is expressed as a numerical value, a/b, where a (redness) and b (yellowness) are reflectance readings obtained with a Gardner Automatic Color Difference Meter. [c/] [d/] The higher the value the more intense the color. The determinations reported in the table were made on juice obtained from early season red grapefruit which was harvested when its visual color rating was about at "its peak" (3). As the suspended solids content of the juice increases, its color (pigment content) also increases.

Figures 1, 2, and 3 show graphically the same kind of data given in Table 1 for red grapefruit harvested at each of three intervals during the 1956-57 season. In addition the figures show the inter-relationship between the numerical color rating and the percent naringin (1) and the percent suspended solids. They also indicate ranges of percent suspended solids within which canned juice products of acceptable color could have been commercially produced from red grapefruit harvested on the dates specified.

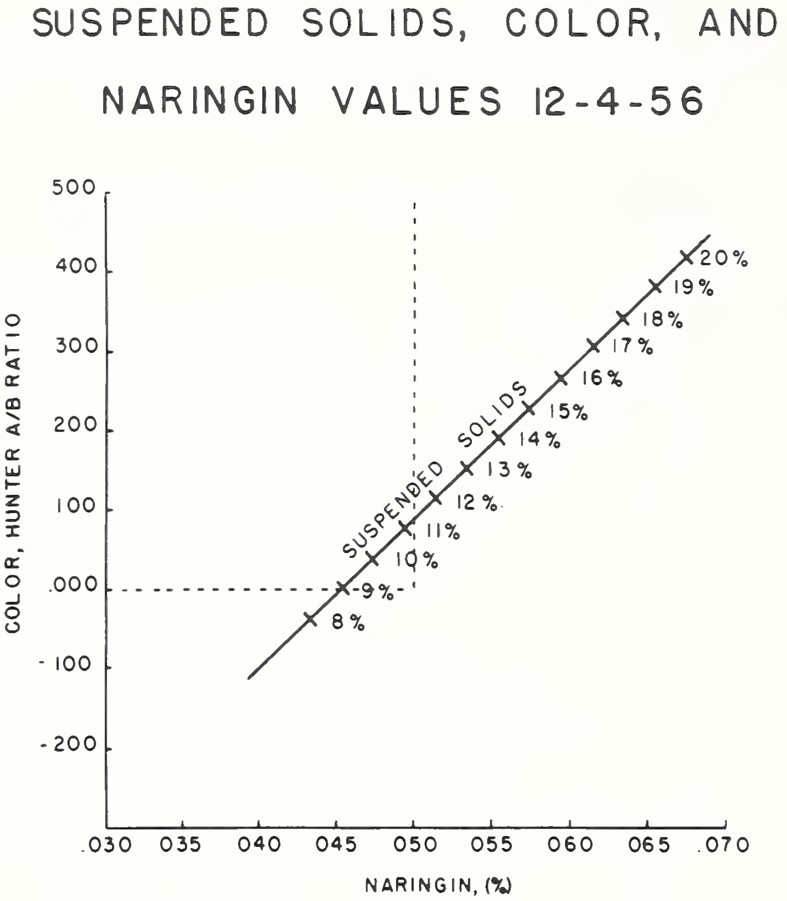
[c/] The mention of a commercial instrument does not imply that it is endorsed or recommended by the U. S. Department of Agriculture over other commercial instruments having the same or similar functions.

[d/] The Gardner Automatic Color Difference Meter was calibrated against a standard color plate LR1 with reflectance values of Rd 45.1, a +20.5, b +7.7.

Table I. Relationship between suspended solids content of red grapefruit juice and color (a/b reflectance ratio).

Suspended solids (%)	a/b (Reflectance ratio)[1]
Sample 1	
8	-.022
10	.302
14	.525
18	.714
20	.824
22	.917
Sample 2	
9	.000
13	.337
16	.598
18	.712
20	.785
22	.904

[1] Numerical color designation.



SUSPENDED SOLIDS, COLOR, AND NARINGIN VALUES 12-4-56

Figure 1. Juice processed December 4, 1956, with suspended solids of 9% to 11%, had adequate color and was below the maximum naringin level, as shown by dotted lines.

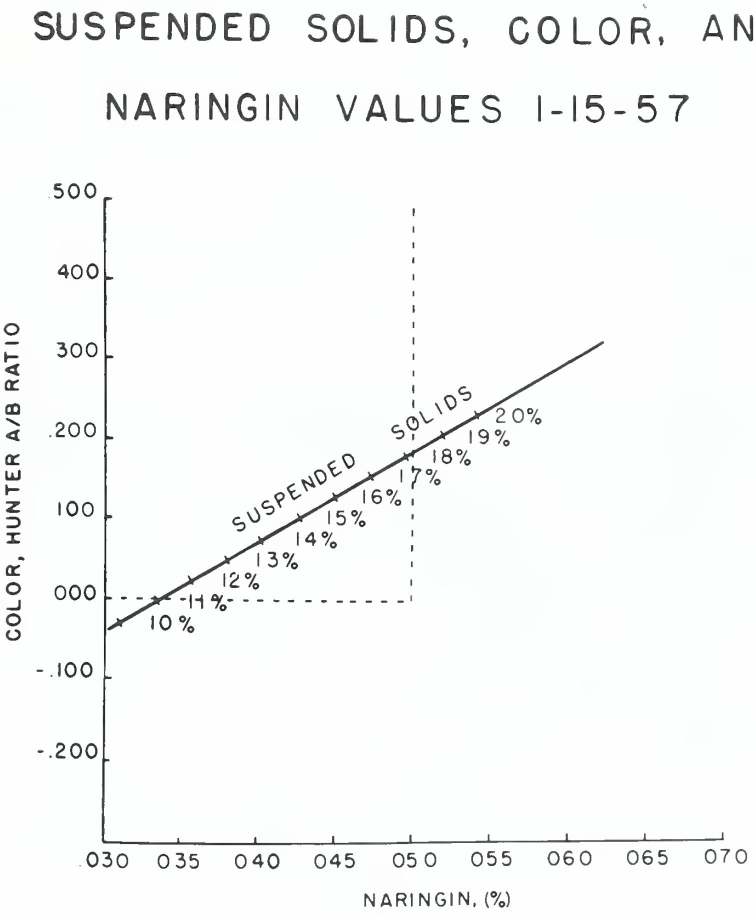


Figure 2 Juice processed January 15, 1957, with a suspended solids of 11 to 18% had adequate color and was below the maximum naringin level, as shown by dotted lines.

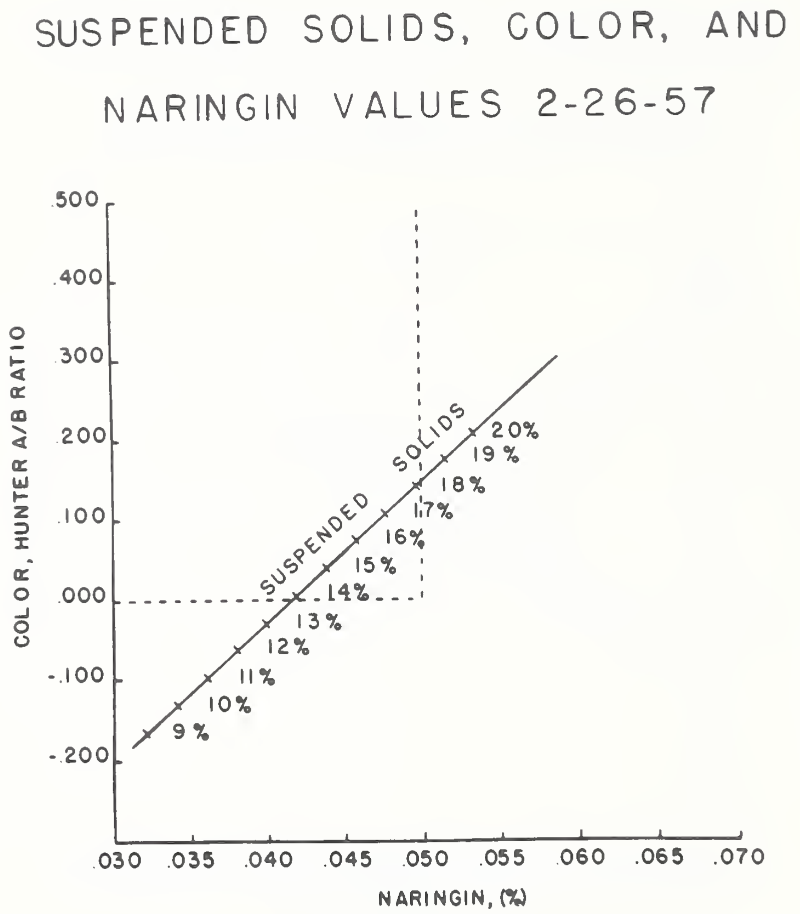


Figure 3. Juice processed February 26, 1957, with a suspended solids of 14 to 18% had adequate color and was below the maximum naringin level, as shown by dotted lines.

The vertical scale is a numerical notation of the color of the juice product. The a/b value of .000 - arrived at from the evaluation of unpublished data - was chosen as an acceptable numerical color designation. A red grapefruit juice product with a reading of .000 and above is considered acceptable from the color standpoint.

The horizontal values in the graphs are percent naringin values. An upper limit of acceptability of 0.050 percent was selected, based on taste experience. The color of the juice was plotted against the naringin value at the various suspended solids levels shown.

Fig. 1 is data plotted from juice of fruit harvested December 4, 1956. The graph indicates that a juice product having a suspended solids content of 9.0% to 11.0% would have a good color and would not be too bitter. Fig. 2 shows data from fruit harvested January 15, 1957. This figure indicates that a fruit product having a suspended solids value from 11.0% to 18.0% would be acceptable. Fig. 3 shows the same type of data from fruit harvested February 26, 1957, and indicates the suspended solids content would have to be increased to 14.0% to obtain an acceptable color in the juice.

Similar charts may be prepared by taking two representative samples of fruit: A low suspended solids sample, prepared by passing the extracted juice from one sample through a finisher with a fine screen under slight pressure; and a higher suspended solids sample, prepared by passing the extracted juice from the other sample through a finisher with a coarse screen with higher pressure and refinishing the pulp when necessary until all the usable pulp is obtained. The color and naringin values of these two samples can be plotted and the various suspended solids levels between these samples estimated. It is suggested that charts as described above should be prepared in each processing plant at intervals throughout the processing season and used as guides to determine the proper pulp levels. A meter showing color differences would not be essential. Other methods of color rating could be used such as direct comparison with color plates or with selected preserved juice samples.

Adjustment of Colored Pulp Levels for Juice Fortification

If all the edible portions of the red grapefruit are obtained in the extraction process and none are lost in the finishing process, the suspended solids content of the juice will be between 22 and 26 percent. This represents the maximum available level. A wide range of suspended solids levels under the above maximum can be obtained with a paddle finisher by varying the screen sizes and pressure within the finisher. A high pulp content juice can be obtained by substituting brushes for the paddles on the paddle type finishers. A suggested method of obtaining extra pulp, free of seeds and defects, for addition to low pulp juices, is by reprocessing pulp from the normal finishing operation through a second paddle finisher equipped with the brushes instead of the usual paddles.

In the preparation of juice products having a high suspended solids content it sometimes becomes necessary to use mechanical means to finely divide the pulp particles to keep them in suspension, to help "smooth the juice to taste," and possible to aid the improved retention of color in the canned product. Since the juice lines of each processing plant are somewhat different, it is difficult to make any specific recommendations as to the best method for each plant to employ in order to finely divide the pulp. In plants where the juice comes in contact with high speed centrifugal pumps and is recirculated through these pumps several times, the pulp is broken into fine particles. In other plants where little agitation of the juice is employed, some type of colloid mill or comminuting machine should be used.

Investigations are underway to determine the practicability of freezing or pasteurizing highly colored pulp from early season fruit for use in juice from less highly colored late season fruit. If this is possible the processor will be able to can pulp-fortified juice throughout the processing season which is more uniform in color, suspended solids, naringin, and other quality characteristics.

Selection of Red Grapefruit for Juice Products

For the production of the best quality colored juice, white, pink, and red fruit must be separated and only the higher colored red fruit used for red juice. Small amounts of pink or white fruit tend to dilute the red color and produce a poorly colored product. Juice of pink fruit may be utilized by blending with an excess of juice from white fruit. Some canners have encouraged the delivery of red grapefruit, unmixed with pink or white, by paying a lower price per ton for mixed loads. Texas red grapefruit, harvested between the middle of December and the last of February, is generally more suitable for juice with respect to color, naringin, and Brix-acid ratio than fruit harvested earlier or later in the season.

Storage of Pulp-Fortified Red Grapefruit Juice

Storage studies, published (2) and unpublished, have shown that pulp-fortified juice retains a good color after 1 year of storage at room temperature (75-90°F.). After 1 1/2 years of storage at room temperature a slight browning occurred, but less browning was detected in the juice containing high pulp than in the control with a low pulp content. Juice samples were also stored at 68 and 40° F. After 1 1/2 years little difference was detected in the color of the samples stored at the two lower temperatures, but both were superior to the samples stored at room temperature. It is recommended that the juice products from red grapefruit be stored at as low a temperature as is economical. In many cases the proper night ventilation of storage sheds would reduce the temperature to a more satisfactory range, thus protecting the juice from adverse taste and color changes.

Merits of Canning a Pulp-Fortified Red Grapefruit Juice

There are several reasons why the production of a canned single-strength pulp-fortified red grapefruit juice might be worth the consideration of both the processor and the consumer. From the processor's standpoint his juice yield would be increased possibly by as much as two cases (24 No. 2 cans per case) per ton of fruit. Less of his raw material would be going into a low value dehydrated feed product and more of it would be going into a higher value food product. There would be less waste and byproduct material to handle. A distinctive juice product would be developed for red grapefruit which might well increase the demand for this variety of fruit.

By the production of a high quality product the consumer would be provided with a new, colorful, and appetite-appealing food product. Moreover, because of increased solids and provitamin A (B-carotene) content, the pulp-fortified red grapefruit juice might have a slight nutritional advantage over most other canned single strength grapefruit juice products presently being manufactured.

The fact is not overlooked that the processor may incur additional costs in endeavoring to manufacture a good quality pulp-fortified red grapefruit juice. This is all the more reason why the product should be manufactured and sold as a premium grade product.

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